

REPORT DOCUMENTATION PAGE

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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE November 14, 1997		3. REPORT TYPE AND DATES COVERED Final Report 07/01/94 - 06/30/97	
4. TITLE AND SUBTITLE AASERT94 NOVEL MATERIALS AND DEVICES FROM SELF-ASSEMBLED PERIODIC STRUCTURES				5. FUNDING NUMBERS F49620-94-1-0268 Hugh C. De Long, Capt. 3484/XS 61103D	
6. AUTHOR(S) Sanford A. Asher				8. PERFORMING ORGANIZATION REPORT NUMBER AFOSR-TR 97-060A	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of Pittsburgh Department of Chemistry Pittsburgh, PA 15260				10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) AFOSR/ANL 110 Duncan Avenue Suite B115 Bolling AFB, DC 20332-0001				12b. DISTRIBUTION CODE	
11. SUPPLEMENTARY NOTES					
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited.				13. ABSTRACT (Maximum 200 words) We request funding for one graduate student to work on a research program focused on developing new devices prepared from self-assembling submicron periodic structures. The work involves synthesis of new colloidal materials that can be used to create self-assembled submicron periodicities, which will be used to develop new devices in the fields of optics, spectroscopy and separation science. We will create these submicron periodicities by utilizing the unique self-assembling property of monodisperse charged colloids; charged colloids self-assemble in solution to form BCC or FCC crystalline arrays (periodicities). We will examine the underlying physical phenomena responsible for this self-assembly process and will optimize the experimental conditions to prepare large defect free crystals. These crystals Bragg diffract light with extremely high efficiencies and are ideal for optical filtering applications. The additional student funded by the AASERT program will allow us to increase our efforts in the fabrication of nonlinear optical switchable devices, and will allow us to explore the utility of our polymerized membranes containing submicron periodic arrays as new materials useful for membrane size selective particle filtering applications.	
14. SUBJECT TERMS DTIC QUALITY INSPECTED 4				15. NUMBER OF PAGES 4	
				16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT U	18. SECURITY CLASSIFICATION OF THIS PAGE U	19. SECURITY CLASSIFICATION OF ABSTRACT U	20. LIMITATION OF ABSTRACT UL		

Objectives:

There has been no change in the objectives of the proposed work.

Status of Efforts:

We have made great progress in the development of novel crystalline colloidal array (CCA) devices for optical and chemical sensing applications. We have synthesized novel polymerized CCA materials (PCCA) containing chemical recognition agents that change volume in response to analytes in the surrounding medium. The PCCA diffracts light from the embedded cubic array of colloidal particles. Binding of analytes to the recognition agents causes the PCCA volume to change, which causes the wavelength of the diffracted light to change. We have created a new, highly selective and sensitive chemical sensing motif.

Accomplishments:

1. Invention of new chemical sensing material. We demonstrated 20 ppb sensing of Pb^{2+} and 10^{-12} M levels for glucose and the ability of the glucose sensor to measure O_2 concentrations (see references 1-3). The sensing material diffracts light from its BCC array of colloidal particles.
2. Development of a theoretical understanding of the sensing phenomenology (ref 2).
3. Development of a fiber optic optrode sensor which utilizes the sensing PCCA materials to remotely sense analytes.
4. These materials can also be used for thin film 2-D display devices. The wavelength diffracted from the PCCA can be controlled by defining the concentration of analyte at various points of the PCCA film. Colored images can be created by, for example, electrochemically introducing the analytes at different points using an electrode array attached to the PCCA film.

Personnel Supported:

John Holtz, graduate student. Ph.D. July, 1997

Publications:

1. "Intelligent Polymerized Crystalline Colloidal Array Hydrogel Film Chemical Sensing Materials", J. H. Holtz and S. A. Asher, *Nature* **389**, 829-832 (1997).
2. "Intelligent Polymerized Crystalline Colloidal Arrays: Novel Chemical Sensor Materials", J. H. Holtz, J. S. W. Holtz, C. H. Munro, and S. A. Asher, *Anal. Chem.*, in press (1997).
3. "Novel Polymerized Crystalline Colloidal Array Sensors", S. A. Asher and J. H. Holtz, U.S. Patent filed (1996).

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4. "Optically Nonlinear Crystalline Colloidal Self Assembled Submicron Periodic Structures for Optical Limiters", S. A. Asher, S.-Y. Chang, A. Tse, L. Liu, G. Pan, Z. Wu, and P. Li, *Mat. Res. Soc. Symp. Proc. Vol. 374*, 305-310 (1995).
5. "Crystalline Colloidal Array Optical Switching Devices", S. A. Asher and G. Pan, in Nanoparticles in Solids and Solutions (J. H. Fendler and I. Dékány, eds.), NATO ASI Series Vol. 18, pp. 65-69, Kluwer Academic Publishers, Dordrecht (1996).

Transitions:

a. Presentations:

- | | |
|---|-----------------|
| • Gettysburg College, Gettysburg, PA | September, 1994 |
| • University of British Columbia, Dow Lecturer, Vancouver, BC | October, 1994 |
| • FACSS Meeting, St. Louis, MO | October, 1994 |
| • University of South Carolina, Columbia, SC | December, 1994 |
| • University of Windsor, Windsor, Ontario, Canada | December, 1994 |
| • Materials Research Society Optical Limiters Symposium, Boston, MA | December, 1994 |
| • Pennsylvania State University, State College, PA | February, 1995 |
| • Carnegie Mellon University, Pittsburgh, PA | February, 1995 |
| • Wright Patterson Air Force Base, Dayton, OH | May, 1995 |
| • Pittsburgh Plate Glass, Pittsburgh, PA | June, 1995 |
| • Hamilton College, Clinton, NY | October, 1995 |
| • Materials Research Society Meeting, Boston, MA (2 lectures) | December, 1995 |
| • Pacifichem '95, Honolulu, Hawaii | December, 1995 |
| • Wayne State University, Detroit, MI | February, 1996 |
| • NATO Advanced Research Workshop, Nanoparticles in Solids and Solutions, Szeged, Hungary | March, 1996 |
| • Clarkson University, Potsdam, NY | March, 1996 |
| • Conover Lecture, Vanderbilt University, Nashville, TN | October, 1996 |
| • Pittsburgh Conference, Atlanta, GA | March, 1997 |
| • Optical Society, Pittsburgh, PA | March, 1997 |
| • Materials Research Society Meeting, San Francisco, CA | April, 1997 |
| • American Chemical Society Meeting, San Francisco, CA | April, 1997 |
| • Eastman Kodak, Rochester, NY | May, 1997 |

- b. We are utilizing the results of this work in our ONR research program and also a research program funded by the DARPA Hide program.
- c. The University of Pittsburgh is negotiating licensing of this technology to a number of companies.

ATTACHMENT

AUGMENTATION AWARDS FOR SCIENCE & ENGINEERING RESEARCH TRAINING
(AASERT)
REPORTING FORM

The Department of Defense (DoD) requires certain information to evaluate the effectiveness of the AASERT Program. By accepting this Grant which bestows the AASERT funds, the Grantee agrees to provide 1) a brief (not to exceed one page) narrative technical report of the research training activities of the AASERT-funded student(s) and 2) the information requested below. This information should be provided to the Government's technical point of contact by each annual anniversary of the AASERT award date.

1. Grantee identification data: (R&T and Grant numbers found on Page 1 of Grant)

a. University of Pittsburgh
University Name

b. F49620-94-1-0268
Grant Number

c. _____
R&T Number

d. Sanford A. Asher
P.I. Name

e. From: 07/01/94 To: 06/30/97
AASERT Reporting Period

NOTE: Grant to which AASERT award is attached is referred to hereafter as "Parent Agreement".

2. Total funding of the Parent Agreement and the number of full-time equivalent graduate students (FTEGS) supported by the Parent Agreement during the 12-month period prior to the AASERT award date.

a. Funding: \$ 146,687

b. Number FTEGS: 2

3. Total funding of the Parent Agreement and the number of FTEGS supported by the Parent Agreement during the current 12-month reporting period.

a. Funding: \$ 155,146

b. Number FTEGS 2

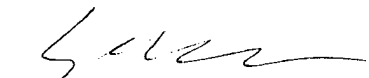
4. Total AASERT funding and the number of FTEGS and undergraduate students (UGS) supported by AASERT funds during the current 12-month reporting period.

a. Funding: \$ 119,025

b. Number FTEGS: 2

c. Number UGS: 0

VERIFICATION STATEMENT: I hereby verify that all students supported by the AASERT award are U.S. Citizens.



Principal Investigator

November 14, 1997

Date